Summary of "Why do Rural Alberta Women Bypass Their Nearest Hospital for Delivery?"

By C. Truman, M. MacGillivray, Y. Jin, E. Ellehoj, and D. Johnson

Purpose

This study assessed if the rate of Alberta rural women who bypass their nearest local rural hospital for delivery was influenced by health services used during birth or the range of obstetric services offered at the nearest rural hospital.

Rural was defined as being greater than one hour in driving time from a regional or metropolitan hospital, and bypass as a live hospital birth not occurring in the nearest Alberta hospital with obstetrical capability. Nearest was based on driving time taking speed limits and road type into consideration.

Approach

Alberta Health and Wellness administrative data and Alberta Vital Statistics data from April 1, 1997 to December 31, 1999 were used.

Key findings

The following are the key findings for this study:

- The overall delivery bypass rate for rural Alberta women was 39.2% (6,032 of 15,376 deliveries).
- In two-thirds of cases in which rural Alberta women bypassed, the delivery took place in a metropolitan or urban hospital.
- The bypass rate for 47 individual rural hospital catchment areas ranged from a low of 10.1% to a high of 86.6%.
- No easily discernible bypass pattern by rural catchment areas was found. Catchment areas with low, medium and high bypass rates were distributed across the province and located proximal to regional and metropolitan catchment areas.
- Older maternal age at delivery nonsingleton birth, first time live birth, previous stillbirth or neonatal death, not having at least one prenatal physician visit, the presence of maternal reproductive comorbidity, diabetes or hypertension were all associated with higher bypass rates.
- The relationship between bypass rate and travel time from the women's residence postal code to the nearest regional or metropolitan hospital was not unimodel. Bypass rate increased up to 120 minutes of travel time, decreased between 180 and 240 minutes, and increased for those with a travel time exceeding 240 minutes (predominately these living in remote Northern Alberta).
- Delivery of a neonate of less than 37 weeks gestation, the presence of fetal coexisting comorbidity associated with pregnancy, being small for gestational age, or having a birth weight of less than 2,500 grams were all positively correlated with bypass rate.

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- Nearest facility having a high volume provider or an obstetrician, an annual delivery volume greater than the median for all Alberta hospitals, or the capability to provide epidural analgesia, Cesarean section or VBAC was negatively correlated with delivery bypass rates.
- Individual delivery characteristics associated with bypass mirrored serve capability at the nearest hospital. Delivery by a high volume provider, obstetrician participation, delivery in a high volume hospital, receiving epidural analgesia during vaginal delivery, having a Cesarean section or being medically induced were all associated with higher bypass rates.
- The two covariates identified as being the most influential were obstetrician participation in the delivery and delivery in a high volume hospital.

Conclusions

Many rural Alberta women are willing to travel up to two hours in order to deliver in a regional or metropolitan or at another rural facility in which they can receive more specialized obstetrical care or be attended by an obstetrician. Delivery repatriation initiatives need to take these preferential service patterns into consideration. Identifying and strengthening appropriately located centres of obstetric excellence on a collaborative basis may be of more value than trying to augment widely dispersed rural delivery services.

For more information

Copies of the report are available from the

Alberta Centre for Health Services Utilization Research

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Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

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SUMMARY

The overall delivery bypass rate for rural Alberta women was 39.2 percent (n=6,032). In two-thirds of cases in which rural women bypassed (66.7 percent, n=4,021) delivery took place in a metropolitan or urban hospital. The bypass rate for the forty-seven individual rural hospital catchment areas ranged from a low of 10.1 percent to a high of 86.6 percent (Table 1). No easily discernible bypass pattern by rural catchment areas was found (Figure 1). Catchment areas with low, medium and high bypass rates were distributed across the province and located proximal to regional and metropolitan catchment areas. Bypass was positively correlated with a number of maternal, neonate and delivery characteristics, as well as, service and provider capability at the nearest hospital.

INTRODUCTION

In 1995, Alberta's health system devolved from provincial to more local management through the establishment of seventeen regional health authorities. Health authorities were given the legislated mandate to assess and meet the health needs of their populations. Existing local hospital boards and health units were organized under this new regional governance and administrative entity. Devolution was expected to improve service planning and priority setting, and to increase coordination of care between health providers and service sectors through the identification of local service gaps and the elimination of duplicate services.

Alberta Health and Wellness (AHW) developed a population-based funding formula with an import and export adjustment designed to allow funding to follow patient flow for the new regions. A region providing services to out-of-region residents received additional funding for services provided to out-of-region residents and the resident region had an equal amount deducted. Initially, resource group number (RGN) weights and, later, Case Mix Group ^{TM} (CMG) weights were used in conjunction with the AHW provincial costing data to calculate inpatient-funding adjustments.

Several rural health regions identified delivery services as a repatriation priority. This study was undertaken within this context. Vital Statistics and administrative health service data were used to identify maternal and neonate, service capability and delivery characteristics that might be expected to influence expectant rural Alberta women to bypass their nearest hospital with obstetric capacity in order to deliver at a more distant hospital. A special feature of the study is a number of methodological innovations that may be useful for future studies of this nature, in particular, the definition of 'rural' and 'urban' and the determination of geographic distance to services. The results of the study are expected to inform potential rural obstetrical repatriation initiatives.

METHODS

Administrative Databases Used:

Alberta's Vital Statistics Birth Registration and three Alberta Health Wellness administrative databases were used. Due to the small number of births in some rural hospitals data for a three-year period were used:

1. Alberta Vital Statistics Birth Registration Database (1997, 1998, 1999),
2. Canadian Institute for Health Information's (CIHI) Alberta Inpatient Discharge Abstract Database (DAD) (1997/1998, 1998/1999, 1999/2000),
3. Alberta Health and Wellness Population Registration file (1997/1998, 1998/1999, 1999/2000), and
4. Alberta Physician Claims Assessment System Database (CLASS) (1997/1998, 1998/1999, 1999/2000).

Step 1: Identifying the Deliveries:

Alberta DAD data was used to identify the Alberta women who delivered live infants in an Alberta hospital with obstetric capacity between April 1, 1997 and December 31, 1999; a total of 102,725 deliveries. Obstetrical capacity was defined as the presence of one or more DAD separation records with a code of "51" (obstetrics delivered) in the main patient service field during each of the study years. Over ninety-nine percent of Alberta women give birth in an acute care hospital. Deliveries occurring in the final three months of the 1999/2000 fiscal year and deliveries for Albertans who delivered at the Lloydminster General Hospital in Saskatchewan were excluded because vital statistics birth information for these newborns was unavailable. Also excluded were residents of the six small Alberta communities for which the Lloydminster General Hospital was identified as the nearest hospital with obstetric capacity (Blackfoot, Kitscoty, Marwayne, Paradise Valley, Rivecourse and Streamstown).

Step 2: Linking to Other Administrative Datasets and Adding Descriptive Information:

Alberta Vital Statistics Birth Registration – because this database does not contain a personal health number (PHN) a deterministic linkage using neonatal birth date (365 unique values), birth weight (3,007 unique values), delivery site (eighty-seven unique values), neonatal sex, and maternal age (thirty-nine unique values) were created. Descriptive information added to the DAD delivery records included: weeks of gestation, multiple births, first time live birth, previous stillbirths or neonatal / infant deaths, small for gestational age and antenatal physician visits.

DAD newborn records – The Alberta Health and Wellness Population Registration file group number was used to link DAD birth separation records (main patient service area fifty-four) to the corresponding DAD delivery records and a Y/N field variable to identify the presence or absence of an existing neonatal comorbidity (developmental, fetal, placenta or intra uterine problems (ICD-9-CM 655.x – 658.c) and birthweight were added.

Physician Claims Assessment System Database (CLASS) - DAD delivery record PHNs were used to identify corresponding CLASS billing records with a Schedule of Medical Benefits (SMOB) procedure code of 87.98A or 87.98C (delivery) or 16.91C (epidural / spinal analgesia). Physician specialty and anaesthetic technique information from CLASS was added to the DAD delivery records for vaginal deliveries. When more than one physician submitted a delivery claim for a single delivery the following hierarchy was used to assign the specialty value: (1) obstetrician, (2) general surgeon then (3) family / general physician. For those DAD delivery records containing ICD-9-CM Cesarean section procedure codes (74.0, 74.1, 74.2, 74.4 or 74.99) in any of ten procedure code fields the DAD physician specialty information and anesthetic technique information was retained. The unique physician identifier found in CLASS was used to create a high volume flag to identify those physicians who delivered or assisted with twenty-five or more deliveries per year during the study period. The number of deliveries was pro-rated to the percent of the study period during which each physician submitted claims (i.e. between the first and last CLASS service date).

Alberta Health Care Insurance Registry Database - The DAD delivery record PHN was used to create two health care insurance payment flags. Women who had their Alberta Health Care Insurance premium paid by the Department of Indian and Northern Affairs (DIAND) received an aboriginal treaty status flag, and those who received premium subsidy received a low socioeconomic status flag. During the study period the upper limit eligibility cut-off for receiving a premium subsidy in Alberta was a reported personal income of about $12,000.

A total of 81,418 (seventy-nine percent) of the 102,725 extracted DAD delivery records were successfully linked across all data sets. The distribution of the mother's age at birth between the linked and unlinked records was similar.

Step 3: Identifying Rural Deliveries:

A rural Albertan was defined as an individual with a valid Personal Health Insurance Number (PHN) and a rural postal code as seen in the Alberta Health and Wellness (AHW) Health Care Insurance (HCIP) Population Registration File. A rural postal code was defined as a postal code that was greater than sixty minutes in travel time from any regional or metropolitan hospital. Regional and metropolitan hospitals in Alberta include the: Lethbridge Regional Hospital, Medicine Hat Regional Hospital, Red Deer Regional Hospital Centre, Queen Elizabeth II Hospital (Grande Prairie), Northern Lights Regional Health Centre (Fort McMurray), Crossroads Hospital and Health Centre (Wetaskwin), as well as all acute care hospitals located within the Calgary or Capital Health Regions.

Nineteen percent (n=15,376) of the 81,418 successfully linked DAD delivery records were attributed to rural Alberta women.

Step 4: Identifying the Nearest Rural Hospital:

The mother's postal code at the fiscal year-end in the AHW Population Registration file was used as a start point for identifying the nearest rural hospital. Driving distance between this postal code and the hospital postal code for each rural Alberta hospital with obstetric capacity was calculated using ARC View v3.2 (ESRI, Redlands, California) and the street network file for Alberta from Health Canada's Spatial Data Warehouse based on Statistics Canada's street network file. Speed limits by road category were then attached to the street network file (large highways - 110 km/hr, other primary highways - 100 km/hr, secondary paved highways – 80 km/hr, arterial roads – 60 km/hr, streets – 50 km/hr) in order to calculate expected driving time. A twenty second adjustment was made for every level road crossing to account for slowing down and/or waiting at stop signs or traffic signals, and a correction factor for the more remote communities based on road category (gravel, ice road, etc.) was added. Three hundred postal code centroid distance pairs calculated using this methodology and representing a variety of distance ranges were tested against known standards. Three additional variables were then added to each DAD delivery record, driving time to the nearest rural hospital with obstetric capacity, driving time to the delivery hospital, and a Y/N bypass flag to indicate whether or not the delivery occurred in the nearest hospital.

Step 5: Creating Hospital Catchment Areas:

Forty-seven unique rural Alberta hospital catchment areas for delivery were created. Catchment area assignment was based on the geocoded Population Registration file residence postal associated with each of the extracted DAD delivery records. Voronoi polygons enclosing all of the nearest postal codes were then created around each of the forty-seven hospitals using Map info. When the driving time from a single geocoded residence postal code to more than one rural hospital with delivery capacity was identical (n=six) the postal code was assigned to the hospital catchment area in which the majority of the postal code residents delivered.

Step 6: Grouping Covariates Expected to influence delivery bypass:

Thirty covariates expected to influence delivery bypass were created based on the information contained in the linked records.

(a) Maternal Characteristics included:

- Fiscal year at discharge (1997/1998, 1998/1999, 1999/2000),
- Maternal age in years at admission date (less than seventeen, seventeen to forty, greater than forty),
- Alberta Health Care Insurance plan (AHCIP) payment status (DIAND, premium subsidy),

- Nonsingleton birth,
- First time live birth,
- Previous stillbirths or neonatal death,
- Having at least one prenatal physician visit,
- Maternal reproductive comorbidity associated with pregnancy *,
- Maternal hypertension *,
- Maternal diabetes *, and
- Driving time from women's residence to the nearest regional or metropolitan facility (> 60 minutes to 90 minutes, > 90 minutes to 120 minutes, > 120 minutes to 180 minutes, > 180 minutes to 240 minutes, > 240 minutes).

(b) Neonate Characteristics included:

- < 37 weeks gestation,
- Fetal coexisting comorbidity associated with pregnancy (developmental problems, fetal placenta or uterine problem *,
- Small for gestational age, and
- Birth weight (< 2,500 grams, 2,500 to 4,000 grams, > 4,000 grams).

(c) Capability at Nearest Rural Hospital:

- Presence of high-volume provider(s),
- Presence of an obstetrician(s),
- Hospital delivery volume above the median number for all Alberta hospitals as averaged over the entire study period,
- Availability of epidural analgesia for one or more vaginal deliveries *,
- Cesarean births *, and
- Vaginal birth after Cesarean section or failed trial of labour *.

(d) Delivery Characteristics included:

- Delivery by a high volume provider,
- Obstetrician participation in delivery,
- Epidural analgesia for vaginal delivery,
- Delivery in a hospital with annual delivery volume greater than the median of all Alberta hospitals averaged over study years,
- Cesarean section *,
- Planned Cesarean section *,
- Vaginal birth after Cesarean section *,
- Use of medical induction *, and
- Use of forceps or vacuum *.

* Maternal and neonate covariates were based on the presence of any of the following ICD-9-CM codes in any of sixteen DAD diagnosis field: maternal reproductive comorbidity associated with pregnancy (i.e. malposition or malpresentation, abnormalities of cervix or uterus, and cephalopelvic disproportion (652.x to 654.x), maternal hypertension (401.x to 405.x and 642.x), maternal diabetes 648.0 x and 648.8 x), fetal coexisting comorbidity associated with pregnancy (i.e. malposition or developmental problems, fetal placenta or uterine problem) (655.x to 658.x). Capability and delivery characteristics were

based on the presence of any of the following ICD-9-CM procedure codes in any one of ten DAD procedural fields: Cesarean section (74.0 - 74.99), 6), vaginal birth after Cesarean section (previous Cesarean section (654.21) without a Cesarean section during current delivery, or Cesarean section with a failed trial of labor in any one of sixteen diagnostic fields (660.61), medical induction (73.4), forceps or vacuum (72.0, 72.1, 72.2 x, 72.3 x, 72.4, 72.5 x, 72.6, 72.71, 72.79, 73.3). Planned Cesarean section was defined as an elective hospital admission for a Cesarean section with a birth between 8:00 a.m. to 12:00 a.m.

FINDINGS AND DISCUSSION

The overall delivery bypass rate for rural Alberta women was 39.2 percent (n=6,032). In two-thirds of cases in which rural women bypassed (66.7 percent, n=4,021) delivery took place in a metropolitan or urban hospital. The bypass rate for the forty-seven individual rural hospital catchment areas ranged from a low of 10.1 percent to a high of 86.6 percent (Table 1). No easily discernible bypass pattern by rural catchment areas was found (Figure 1). Catchment areas with low, medium and high bypass rates were distributed across the province and located proximal to regional and metropolitan catchment areas.

The median number of deliveries per catchment area hospital was 193 for the thirty-three-month period of the study, and the median number of Cesarean sections per catchment area hospital was thirty-three, with twelve of the forty-seven hospitals performing no Cesarean sections during the study period. Obstetrician participation in at least one birth occurred in ten hospitals, and participation in three or more births occurred in four hospitals. Twenty-nine (sixty-two percent) hospitals had one or more VBAC deliveries or repeat cesarean section deliveries following a failed trail of labour, and twenty-nine hospitals provided epidural analgesia for one or more vaginal births. Table 1 about here (shows the number of deliveries and the bypass rate by hospital catchment area).

Univariate analysis indicated that bypass rate was positively correlated with all but two of the identified maternal and three of the identified delivery characteristics. Older maternal age at delivery, nonsingleton birth, first time live birth, previous stillbirth or neonatal death, not having at least one prenatal physician visit, the presence of maternal reproductive comorbidity, diabetes or hypertension were all associated with higher bypass rates. The relationship between bypass rate and travel time from the woman's residence postal code to the nearest regional or metropolitan hospital was not unimodal. Bypass rate increased up to 120 minutes of travel time, decreased between 180 and 240 minutes, and increased for those with a travel time exceeding 240 minutes (predominately those living in remote Northern Alberta). Neither fiscal year at discharge or AHCIP payment status was correlated with delivery bypass rate. Delivery of a neonate of less than thirty-seven weeks gestation, the presence of fetal coexisting comorbidity associated with pregnancy, being small for gestational age, or having a birth weight of less than 2,500 grams were all positively correlated with bypass rate. Nearest facility having a high volume provider or an obstetrician, an annual delivery volume greater than the median for all Alberta hospitals, or the capability to provide epidural analgesia, cesarean section or VBAC was negatively correlated with delivery bypass rates. Delivery characteristics mirrored hospital capability characteristics.

Bypass rates were positively associated with delivery by a high volume provider, obstetrician participation, delivery in a high volume hospital, receiving epidural analgesia during vaginal delivery, having a cesarean section or being medically induced.

Table 2 illustrates the univariate analysis for each of the factors expected to influence delivery.

Multiple logistic regression further reduced the number of covariates significantly associated (0.05) with higher bypass rates. Six maternal and neonate characteristics, four nearest rural hospital capabilities, and six delivery characteristics remained. The two covariates identified as being the most influential were obstetrician participation in the delivery (OR 29.9) and delivery in a high volume hospital (OR 11.6).

Figure 2 illustrates the logistic regression results.

The rural Alberta delivery bypass rate of nineteen percent found in this study was lower than the forty-five percent found in a similar study conducted in Alabama, USA [1], but within the eighteen to forty-four percent range identified by a number of other researchers who looked at bypass rates for a variety of health services delivered by rural hospitals [2-5]. Comparison of bypass rates across studies is, however, problematic due to differences in the range of services included, the definition of what constitutes a bypass, and the methodology used to identify rural residents, create hospital catchment areas and measure travel distance / time. In this study we defined rural in relation to service availability, as being more than one hour in actual travel time taking road category, speed limit and road crossings into consideration from a regional or urban hospital.

Several American bypass studies identified a correlation between bypass rate and age, race, insurance coverage, personal income, out-of-pocket cost, illness characteristics, distance to care and / or hospital attributes [2-5, 6-8]. Our study indicated that income and race, as operationalized using AHCIP payment status information, was not correlated with bypass rates. Because our study was conducted in Canada, where health services are universally available, we did not examine insurance type, nor did we look at out-of-pocket cost. We did; however, find that maternal and neonate comorbidities, distance to care, and hospital capability were positively correlated with delivery bypass rates.

One of the strengths of this study was its use of administrative data. This type of data, which is consistently and rigorously collected on a provincial basis, allowed us to identify and examine the delivery bypass patterns for all rural Alberta women over a thirty-three-month period. On the other hand administrative database variables may not always provide all relevant information. The decision to bypass the nearest hospital for delivery is extremely complex, and is influenced by a range of attitudinal and physician-patient interaction factors [8] not captured in our analysis. A second limitation was our use of postal code centroids to identify start and end travel points. In rural Alberta

postal code centroid is linked to mail delivery location not residence location. A single rural postal code centroid can include people who reside within a fairly large geographic area. Unfortunately postal code is currently the only available identifier that can be used to geolocate service and residence location in provincial administrative health service databases.

CONCLUSION

Rural practitioners and residents frequently identify a need to strengthen and expand rural obstetrical services [9]. Our study indicates that attempting to do this in isolation may lead to unnecessary service duplication. Many rural Alberta women are willing to travel up to two hours in order to deliver in a regional or metropolitan or at another rural facility in which they can receive more specialized obstetrical care or be attended by an obstetrician. Delivery repatriation initiatives need to take these preferential service patterns into consideration. Identifying and strengthening appropriately located centres of obstetric excellence on a collaborative basis may be of more value than trying to augment widely dispersed rural delivery services.

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FIGURE LEGEND

Figure 1 – Delivery Bypass Rates by Quartile for Rural Alberta Hospital Catchment Areas - April 1, 1997 to December 31, 1999

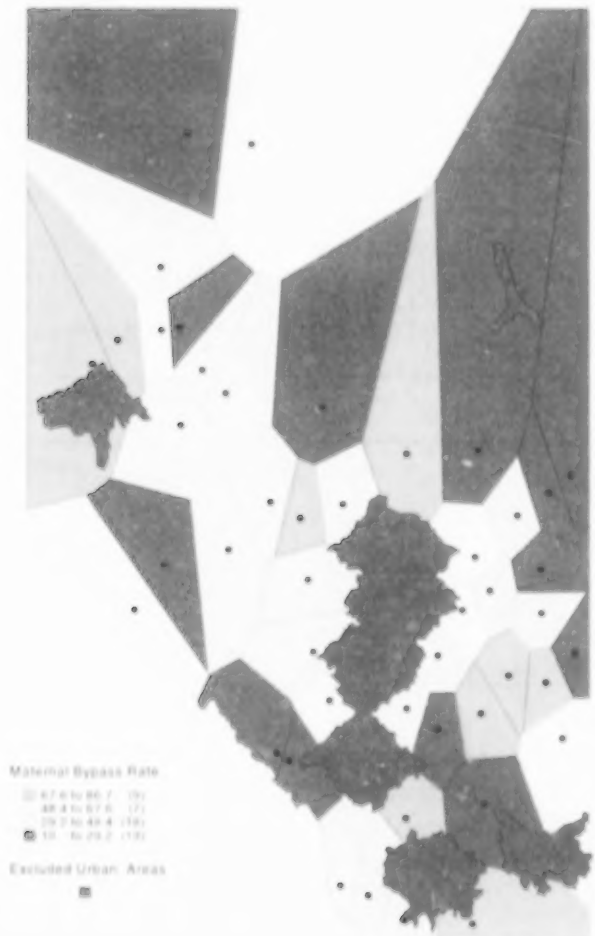

Figure 2 – Odds Ratio and 95% Confidence Interval for Covariates Associated with Delivery Bypass Rate

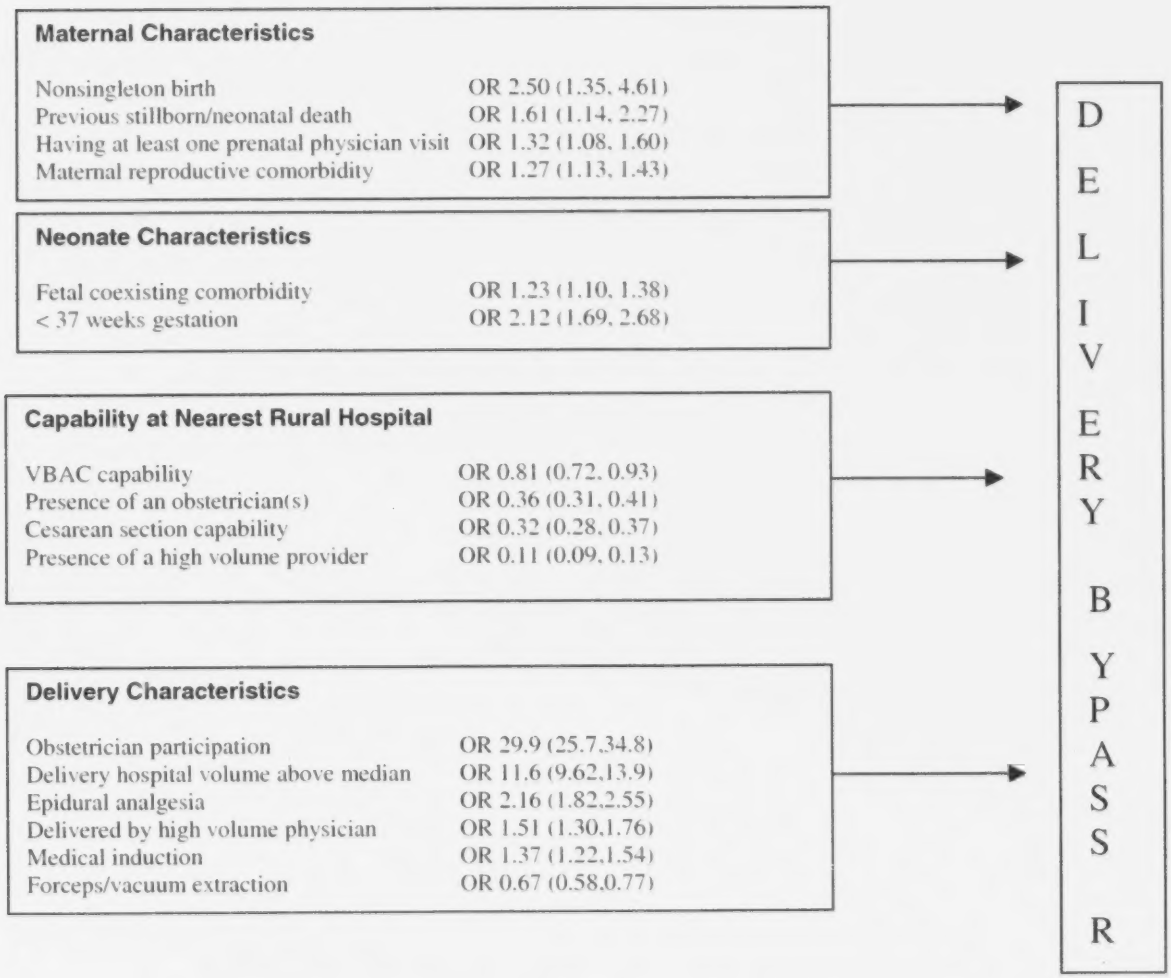
Maternal Characteristics
Nonsingleton birth OR 2.50 (1.35, 4.61)
Previous stillborn/neonatal death OR 1.61 (1.14, 2.27)
Having at least one prenatal physician visit OR 1.32 (1.08, 1.60)
Maternal reproductive comorbidity OR 1.27 (1.13, 1.43)
Neonate Characteristics
Fetal coexisting comorbidity OR 1.23 (1.10, 1.38)
< 37 weeks gestation OR 2.12 (1.69, 2.68)
Capability at Nearest Rural Hospital
VBAC capability OR 0.81 (0.72, 0.93)
Presence of an obstetrician(s) OR 0.36 (0.31, 0.41)
Cesarean section capability OR 0.32 (0.28, 0.37)
Presence of a high volume provider OR 0.11 (0.09, 0.13)
Delivery Characteristics
Obstetrician participation OR 29.9 (25.7,34.8)
Delivery hospital volume above median OR 11.6 (9.62,13.9)
Epidural analgesia OR 2.16 (1.82,2.55)
Delivered by high volume physician OR 1.51 (1.30,1.76)
Medical induction OR 1.37 (1.22,1.54)
Forceps/vacuum extraction OR 0.67 (0.58,0.77)
DELIVERY BYPASS R

Table 1 – Total Number for Deliveries and Delivery Bypass Rate by Hospital Catchment Area, April 1, 1997 to December 31, 1999

Facility	No	Yes	Total	Rate
Drumheller District Health Services	259	29	288	10.2%
Hinton General Hospital	455	58	513	11.3%
Peace River Community Health Centre	377	51	428	11.9%
Banff, Mineral Springs Hospital	137	23	160	14.4%
Cold Lake Health Centre	439	94	533	17.6%
Bonnyville Health Centre	481	110	591	18.6%
Provost Health Centre	126	29	155	18.7%
Lac La Biche, WJ Cadzow Health Centre	383	98	481	20.5%
Vermilion Health Centre	154	42	196	21.4%
Brooks Health Centre	596	169	765	22.1%
High Level General Hospital	310	105	415	25.3%
Slave Lake Health Complex	468	167	635	26.3%
Canmore General Hospital	217	87	304	28.6%
Whitecourt Healthcare Centre	416	177	593	30.0%
Three Hills District Health Services	200	100	300	33.3%
Barrhead Healthcare Centre	269	143	412	34.7%
Stettler Health Centre	212	116	328	35.4%
Claresholm General Hospital	99	57	156	36.5%
Blairmore, Crowsnest Pass Hospital	86	53	139	38.1%
McLennan, Sacred Heart Community Health Centre	107	66	173	38.2%
Cardston Hospital	213	134	347	38.6%
Pincher Creek Hospital	182	115	297	38.7%
Drayton Valley, Crossroads Hospital and Health	400	256	656	39.0%
Viking Health Centre	70	50	120	41.7%
Rocky Mountain House Hospital and Care Centre	297	214	511	41.9%
Manning Community Health Centre	56	41	97	42.3%
High Prairie Health Complex	264	196	460	42.6%
Edson and District Health Care Centre	240	215	455	47.5%
Valleyview Health Centre	121	111	232	47.8%
Wainwright Health Centre	195	180	375	48.0%
St. Paul, St. Therese Health Centre	413	383	796	48.1%
Daysland Health Centre	104	109	213	51.3%
Jasper, Seton Hospital	61	66	127	52.0%
Grimshaw Berwyn Community Health Centre	83	96	179	53.6%
Vegreville, St. Joseph's General Hospital	135	164	299	54.9%
Sundre Hospital and Care Centre	57	75	132	56.8%
Oyen, Big Country Hospital	36	57	93	61.3%
Fort Vermilion, St. Theresa General Hospital	249	513	762	67.3%
Fairview Health Complex	103	230	333	69.1%
Milk River Hospital	13	35	48	72.9%
Hanna District Health Services	49	142	191	74.4%
Vulcan Community Health Centre	36	116	152	76.3%

Table 1 – Continued

Mayerthorpe Healthcare Centre	54	179	233	76.8%
Athabasca Healthcare Centre	68	297	365	81.4%
Consort Health Centre	16	71	87	81.6%
Spirit River, Central Peace Health Complex	19	90	109	82.6%
Coronation Health Centre	19	123	142	86.6%
All Rural Hospital Catchment Areas	**9,344**	**6,032**	**15,376**	**39.2%**

Table 2 – Total Number of Deliveries and Crude Bypass Rates with Ninety-Five Percent Confidence Interval and P Value for Each of the Factors Expected to Influence Delivery Bypass

Covariate		Bypass No	Bypass Yes	Rate (95% CI)	P value
Maternal Characteristics					
Fiscal year at discharge	1997/1998	3,336	2,260	40.4% (39.1-41.7)	0.067
	1998/1999	3,461	2,146	38.3% (37.0-39.5)	
	1999/2000	2,547	1,626	39.0% (37.5-40.4)	
Maternal age at admission	< 17	130	90	40.9% (34.4-47.4)	0.002
	17 – 40	9,170	5,885	39.1% (38.3-39.9)	
	> 40	44	57	56.4% (46.8-66.1)	
AHCIP Payment Status	nonsubsidized	6,399	4,027	38.6% (37.7-39.6)	0.078
	aboriginal	1,318	907	40.8% (38.7-42.8)	
	subsidy	1,627	1,098	40.3% (38.5-42.1)	
Nonsingleton birth	No	9,325	5,861	38.6% (37.8-39.4)	0.000
	Yes	19	171	90.0% (85.7-94.3)	
First time live birth	No	6,131	3,733	37.8% (36.9-38.8)	0.000
	Yes	3,213	2,299	41.7% (40.4-43.0)	
Previous stillbirth / neonatal death	No	9,213	5,885	39.0% (38.2-39.8)	0.000
	Yes	131	147	52.9% (47.0-58.7)	
Having at least one prenatal physician visit	No	586	273	31.8% (28.7-34.9)	0.000
	Yes	8,758	5,759	39.7% (38.9-40.5)	
Maternal reproductive comorbidity	No	7,956	4,322	35.2% (34.4-36.0)	0.000
	Yes	1,388	1,710	55.2% (53.4-56.9)	
Maternal diabetes	No	9,162	5,787	38.7% (37.9-39.5)	0.000
	Yes	182	245	57.4% (52.7-62.1)	
Maternal hypertension	No	8,997	5,520	38.0% (37.2-38.8)	0.000
	Yes	347	512	59.6% (56.3-62.9)	
Driving time in minutes to the nearest regional or metropolitan hospital	> 240	967	879	47.6% (45.3-49.9)	0.000
	181 – 240	1,864	600	24.4% (22.7-26.0)	
	121 – 180	2,708	1,557	36.5% (35.1-38.0)	

Covariate		Bypass		Rate (95% CI)	P value
		No	Yes		
	91 – 120	1,014	1,029	50.4% (48.2-52.5)	
	61 – 90	2,791	1,967	41.3% (39.9-42.7)	
Neonate Characteristics					
< 37 weeks gestation	No	9,127	5,378	37.1% (36.3-37.9)	0.000
	Yes	217	654	75.1% (72.2-78.0)	
Fetal coexisting comobidity	No	7,623	3,985	34.3% (33.5-35.2)	0.000
	Yes	1,721	2,047	54.3% (52.7-55.9)	
Small for gestational age	No	8,650	5,494	38.8% (38.0-39.6)	0.001
	Yes	694	538	43.7% (40.9-46.4)	
Birth weight in grams	< 2500	172	538	75.8% (72.6-78.9)	0.000
	2500 – 4000	7,897	4,692	37.3% (36.4-38.1)	
	> 4000	1,275	802	38.6% (36.5-40.7)	
Capability at Nearest Rural Hospital					
Presence of a high volume provider	No	38	160	80.8% (75.3-39.5)	0.000
	Yes	9,306	5,872	38.7% (37.9-39.5)	
Presence of an obstetrician(s)	No	6,871	5,207	43.1% (42.2-44.0)	0.000
	Yes	2,473	825	25.0% (23.5-26.5)	
Nearest hospital delivery volume above the median	No	2,260	2,688	54.3% (52.9-55.7)	0.000
	Yes	7,084	3,344	32.1% (31.2-33.0)	
Epidural analgesia capability	No	3,722	3,528	48.7% (47.5-49.8)	0.000
	Yes	5,622	2,504	30.8% (29.8-31.8)	
Cesarean section capability	No	817	1,912	70.1% (68.3-71.8)	0.000
	Yes	8,527	4,120	32.6% (31.8-33.4)	
VBAC capability	No	1,847	2,348	56.0% (54.5-57.5)	0.000
	Yes	7,497	3,684	32.9% (32.1-33.8)	
Delivery Characteristics					
Delivered by a high volume provider	No	1,378	407	22.8% (20.9-24.7)	0.000
	Yes	7,966	5,625	41.4% (40.6-42.2)	
Obstetrician participation	No	8,959	2,878	24.3% (23.5-25.1)	0.000
	Yes	385	3,154	89.1% (88.1-90.1)	

Covariate		Bypass		Rate (95% CI)	P value
		No	Yes		
Delivery Hospital volume above median	No	2,265	520	18.7% (17.2-20.1)	0.000
	Yes	7,079	5,512	43.8% (42.9-44.6)	
Epidural analgesia [3]	No	7,425	3,597	32.6% (31.8-33.5)	0.000
	Yes	626	901	59.0% (56.5-61.5)	
Cesarean section delivery	No	8,051	4,498	35.8% (35.0-36.7)	0.000
	Yes	1,293	1,534	54.3% (52.4-56.1)	
Planned cesarean section Delivery [1]	No	952	1,130	54.3% (52.1-56.4)	0.983
	Yes	341	404	54.2% (50.7-57.8)	
VBAC delivery [2]	No	454	551	54.8% (51.7-57.9)	0.307
	Yes	251	339	57.5% (53.5-61.4)	
Medical induction	No	7,761	4,427	36.3% (35.5-37.2)	0.000
	Yes	1,583	1,605	50.3% (48.6-52.1)	
Forceps/vacuum extraction [3]	No	6,626	3,682	35.7% (34.8-36.6)	0.536
	Yes	1,425	816	36.4% (34.4-38.4)	

Note: denominator restricted to:
[1] Cesarean sections
[2] previous Cesarean section
[3] vaginal deliveries

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